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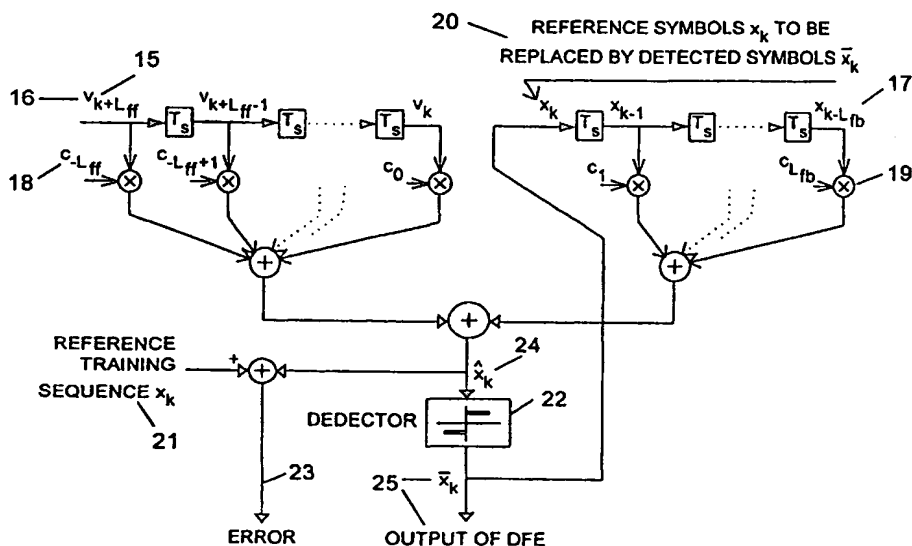
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Published

With international search report.

Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: ADAPTIVE FILTER EQUALISATION TECHNIQUES



(57) Abstract

Multipath communications channels can result in intersymbol interference that requires the use of equalisation techniques to be removed. A method of estimating coefficients of an equaliser filter which receives an input channel signal, includes initialising preselected coefficients of the equaliser filter in accordance with a calculated channel matched filter model, and estimating the coefficients of the filter using an estimation technique and a known input channel signal to the equaliser. Initialising the coefficients in this way enables the training period of the filter to be reduced.

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

14


| | | |
|---|--|---|
| Applicant's or agent's file reference HL57809/001/CIV | | See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416) |
| FOR FURTHER ACTION | | |
| International application No. PCT/GB00/01214 | International filing date (day/month/year) 30/03/2000 | Priority date (day/month/year) 30/03/1999 |
| International Patent Classification (IPC) or national classification and IPC H04L25/03 | | |
| Applicant UNIVERSITY OF BRISTOL | | |

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 6 sheets, including this cover sheet.
 - ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

| | |
|---|---|
| Date of submission of the demand 25/10/2000 | Date of completion of this report 28.06.2001 |
| Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465 | Authorized officer Cretaine, P Telephone No. +49 89 2399 8828 |



INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/01214

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, pages:

1-16 as originally filed

Claims, No.:

1-8 as originally filed

Drawings, sheets:

1/5-5/5 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB00/01214

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | | | |
|-------------------------------|------|--------|-----|
| Novelty (N) | Yes: | Claims | 2-8 |
| | No: | Claims | 1 |
| Inventive step (IS) | Yes: | Claims | |
| | No: | Claims | 1-8 |
| Industrial applicability (IA) | Yes: | Claims | 1-8 |
| | No: | Claims | |

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following documents:

D1 = WO-A-91 17607

D2 = KAYA I. et al.: "Exploiting multipath activity using low complexity equalisation techniques for high speed wireless LANs", VTC '98, 48TH IEEE VEHICULAR TECHNOLOGY CONFERENCE, 18-21 MAY 1998, pages 1593-1597 vol.2, New York, NY, USA.

D3 = EP-A-0 880 253

2. The subject-matter of claim 1 is not new, Article 33(2) PCT. In this respect, D1 discloses, according to all the features of claim 1, a method of estimating coefficients of an equaliser filter which receives an input channel signal (page 2, line 25 to page 3, line 5), the method including initialising preselected coefficients of the equaliser filter in accordance with a calculated channel matched filter model (page 3, lines 21-35), and estimating the coefficients of the filter using an estimation technique and a known input channel to the equalizer (claim 3).

Moreover, it should be noted that even if novelty of **claim 1** could be argued, based on minor differences between the features of this claim and those disclosed in **D1**, the subject-matter of **claim 1** would not involve an inventive step, Article 33(3) PCT, having regard to the disclosure of **D1**.

3. Dependent claims 2 to 8 do not contain any features which, in combination with the features of claim 1 to which they refer, meet the requirements of the PCT in respect of inventive step (Article 33(3) PCT), since these features appear to be disclosed in D1, D2 or D3, or are common measures.

- claim 2: channel matched filter modelisation, see D2, paragraph II, equations (2), (3) and (4); preselected coefficients are feed forward coefficients of the equaliser

filter, see D1; coefficients initialised as complex conjugate of the impulse response coefficients, see D1.

- claim 3: preselected coefficients are feed back filter coefficients, see D1; these coefficients are initialised as autocorrelation values of the channel impulse response coefficients, see D1.

- claim 4: normalising coefficients is a common measure for a skilled person.

- claim 5: LMS, see D2

- claim 6: RLS, see D2

- claim 7: independent training rates for FFF and FBF, see D3, from page 4, line 47 to page 5, line 40.

- claim 8: see D1, page 1593, right-hand column, lines 46-50.

Re Item VII

Certain defects in the international application

1. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the document D1 is not mentioned in the description, nor is this document identified therein.

D2 apparently corresponds to the VTC'98 CONFERENCE cited on page 4, line 10 of the description. However, the date, place and page numbers should have been mentioned.

2. The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/01214

Re Item VIII

Certain observations on the international application

1. In claim 3, the values of d_j are not defined for $j = 1, \dots, L$ when the claim depends on claim 1 (Article 6 PCT).
2. In claim 7, some parameters of the equation are not defined (Article 6 PCT).

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

| | | |
|---|---|--|
| Applicant's or agent's file reference HL57809/001/CIV | FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below. | |
| International application No. PCT/GB 00/ 01214 | International filing date (day/month/year) 30/03/2000 | (Earliest) Priority Date (day/month/year) 30/03/1999 |
| Applicant UNIVERSITY OF BRISTOL | | |

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of Invention is lacking** (see Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☐ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☒ because this figure better characterizes the invention.

8

☐ None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No

P GB 00/01214

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H04L25/03 H04L7/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|---|-----------------------|
| X | WO 91 17607 A (DANCALL RADIO AS ; CETELCO AS (DK)) 14 November 1991 (1991-11-14) abstract; figure 6 page 3, line 21 - line 35 | 1 |
| Y | --- | 2-8 |
| | -/-- | |

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

6 July 2000

Date of mailing of the international search report

25/07/2000

Name and mailing address of the ISA

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Authorized officer

Binger, B

INTERNATIONAL SEARCH REPORT

International Application No

P GB 00/01214

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|--|-----------------------|
| Y | KAYA I ET AL: "Exploiting multipath activity using low complexity equalisation techniques for high speed wireless LANs" VTC '98. 48TH IEEE VEHICULAR TECHNOLOGY CONFERENCE. 18-21 MAY 1998, pages 1593-1597 vol.2, XP002141419 1998, New York, NY, USA, IEEE, USA ISBN: 0-7803-4320-4 cited in the application abstract page 1593, column 1, line 45 -page 1594, column 2, line 50 page 1595, column 1, line 30 - line 42 --- | 2-6,8 |
| Y | EP 0 880 253 A (LUCENT TECHNOLOGIES INC) 25 November 1998 (1998-11-25) abstract page 4, line 47 -page 5, line 40 --- | 7 |
| A | US 5 732 112 A (LANGBERG EHUD) 24 March 1998 (1998-03-24) abstract column 8, line 59 -column 9, line 30; figure 4 ----- | 7 |

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 00/01214

| Patent document cited in search report | | Publication date | Patent family member(s) | Publication date |
|---|---|---------------------|----------------------------|---------------------|
| WO 9117607 | A | 14-11-1991 | DK 107690 A | 02-11-1991 |
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| | | | CA 2233522 A | 23-11-1998 |
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| US 5732112 | A | 24-03-1998 | BR 9612296 A | 13-07-1999 |
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